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Advanced Media Control Through Drawing:

Using a graphics tablet to control complex audio and video data in a live context

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Keywords

Live audio, live video, electronic drawing, electronic music, performance, VJing, MIDI, Max MSP, interface design, transmedia, synaesthesia, graphics tablets, multimedia.

Note

This article contains a number of video files. For any figure marked as a video, please click on the link in the Figure description and the video will play in your browser. You will need QuickTime to play the videos - <http://www.apple.com/quicktime/download/>. Adobe Reader 9 is required to link to the videos from the pdf file - <http://www.adobe.com/products/reader/>

Summary

This paper demonstrates the results of the authors' Wacom tablet MIDI user interface. This application enables users' drawing actions on a graphics tablet to control audio and video parameters in real-time. The programming affords five degrees (x, y, pressure, x tilt, y tilt) of concurrent control for use in any audio or video software capable of receiving and processing MIDI data. Drawing gesture can therefore form the basis of dynamic control simultaneously in the auditory and visual realms. This creates a play of connections between parameters in both mediums, and illustrates a direct correspondence between drawing action and media transformation that is immediately apparent to viewers.

The paper considers the connection between drawing technique and media control both generally and specifically, postulating that dynamic drawing in a live context creates a performance mode not dissimilar to performing on a musical instrument or conducting with a baton. The use of a dynamic and physical real-time media interface re-inserts body actions into live media performance in a compelling manner. Performers can learn to "draw/play" the graphics tablet as a musical and visual "instrument", creating a new and uniquely idiomatic form of electronic drawing. The paper also discusses how to practically program the application and presents examples of its use as a media manipulation tool.

Introduction

Electronic drawing is generally (though not exclusively) limited to pictorial or representational drawing with a pen and graphics tablet in order to produce still images or frames for animations in software such as Adobe Flash. Given the authors' background in media art, physical computing and transmedia applications, we were more interested in the idea of repurposing the graphics tablet as media control device. We were particularly interested in the act of electronic drawing as a means of manipulating sound and video rather than as an output to an actual drawing, whether on-screen or for print. (This concept was initially proposed by Donna Leishman, expert Flash animator and digital artist/writer: <http://www.6amhoover.com/>).



Figure 1 - Korg KAOSS PAD,
<http://www.korg.com/product.aspx?pd=278>

Other 3D “tablet-like” devices have been used for manipulating sound, including the popular Kaoss Pad (<http://www.korg.com/product.aspx?pd=278>) from Korg. These devices are generally very limited in size: the Kaoss Mini KP has the following dimensions: 4.17 in (W) x 5.08 in (D). This version of the Kaoss pad has a very restricted area for media control and in the context of live performance this does not allow for dramatic gesture.

The notion of the dramatic gesture was very important for us since we wanted to use a tablet as the only visible performance element (a Kaoss pad is usually employed as a manipulation device in tandem with a synthesizer). It was imperative that the audience be able to identify performer gesture with perceptible results in the media used (live sound and video in our case). To achieve this aim a larger area for drawing would be required. Finally, another limitation of

other 3D controllers such as the KAOSS pad is that they are **ONLY** 3D. In order to achieve complex control of the media elements through our drawing actions, we wanted to be able to use more than three parameters at a time.

For the above reasons we decided to use a graphics tablet as a control device for gestural performance, and in particular we selected the Intuos 3 from Wacom (now superseded by the Intuos 4 - <http://www.wacom.com/intuos/>). The Intuos 3 is 9 inches x 12 inches in dimension and has five degrees of control. This large surface combined with five possible control parameters made it an ideal choice. Also the fact that one uses a pen with a graphics tablet makes it more useful as a performance instrument, since the pen is a visible object that audience members can identify in much the same way as they would a conductor’s baton (though the audio-visual results we aspired to were quite different from those of an orchestra).

Background: Live music performance as a visual medium

Our interest in repurposing a device such as a graphics tablet for media control stems from the authors’ dissatisfaction with certain modes of electronic music performance. Live music has traditionally been experienced as a partially visual medium, with the visible actions of the performer holding the attention of the listener: “Making music involves not only the communication of musical sounds but is also characterized by a continuously changing and meaningful use of facial expressions, body movements, and hand gestures. Until the late nineteenth century, music performances were almost always experienced as audio-visually integrated activities.” (Graham, Russo and Thompson 2005, p.177)

With the advent of electro-acoustic “tape-based” music in academic electronic music and laptop performance in popular electronic music, the visual reference of the performer became “un-stuck” from the resulting sound produced in a live performance scenario. The relatively long history of tape-based electro-acoustic music has attempted to deal with the lack of performance spectacle by ever-increasing complex “diffusions” of the sound in space. This often involves ever-increasing numbers of speakers placed strategically throughout the room. For example, the BEAST “diffusion” system at Birmingham University has “over 100 discrete channels” of sound available: <http://www.beast.bham.ac.uk/about/index.shtml> .

When used effectively this can create a sort of architectural soundscape, in which the listener follows the sound around the speakers and thereby intuits an image of sound as an object in space, albeit virtually. For the most part though, it is hard to avoid the conclusion that the use of ever-increasing numbers of speakers is a rather desperate ploy to obfuscate the fact that the audience does not easily respond to music in the absence of the visual spectacle of the performer. As experienced listeners of diffused electro-acoustic music, the authors have been



Figure 2 - Classic laptop performer - David Stout, Noisefold, <http://nfold.csf.edu/Pages/Bio.htm>

generally unmoved by the increasingly complex attempts to counter the visual spectacle of the performer with a large array of speakers. In short, in the majority of cases, the tape-music concert is one that generally does not satisfy the audience need for performance complexity. The genuinely live performance event has possibilities for variation, expression, errors, and communication with the listeners/viewers that are lacking in purely tape-based performances.

Similarly, pure laptop-based popular electronic music faces a similar crisis. When the performer is hidden behind the screen, it is simply impossible to recognize or even infer what he or she might be doing. A relatively long-standing joke in laptop music circles asserts that “they could as well be playing a computer game back there.” As with tape-based music, the visual aspect in laptop performance is reduced to a virtually-inferred spectacle at best. (It should be said that in laptop performance there is at least the presence of an actual performer, and though it may be difficult to ascertain his or her actions, at least he or she is generally doing *something* live).

The introduction of physically expressive performance aspects into electronic music has increased in the past ten to fifteen years. With improvements in computer speeds and the growing number of gesturally expressive media control devices available, electronic music has become increasingly engaging within a *genuine* performance context. The laptop is still employed live in most cases, but at least it is being controlled by a performer with some other device that the audience can relate to as an instrument. In this regard the live electronic performance medium (with a physically present and “active” performer) bears some resemblance to the drawing medium, in that deliberate and unconscious gestures in time form a basis for the artist input in both mediums. In both drawing and live performance errors are allowed (or are, at the least, quite inevitable). Meandering, testing, chance, and happy accidents in improvisational or semi-improvisational mediums such as live electronic music or DJing, are quite relatable to doodling, dreaming and sketching in the field of drawing.

Background: The VJ as live performer

It is worth noting that the VJ faces a similar problem to that of the laptop performer: how do his or her actions relate to the music and visual performance and how does the audience perceive those actions as in any way corresponding to the audio-visual results? VJing generally relies

heavily on digital signal processing (DSP), in which the VJ software detects aspects of the incoming audio (e.g. hard attack beats coming from a kick drum) and consequently applies effects, cross-fades, or clip edits based on that information. This normally creates an obvious connection between the audio performance and the resulting visual world, at least on the rhythmic level. The video in Figure 3 below illustrates how these DSP tools allow for a perceptible rhythmic connection to be automatically created between the sound and visual worlds in a live DJ/VJ performance.

While these DSP tools provide a solid automatic connection between the audio and video in a VJ performance, there remains the presence of the VJ performer: as with laptop music performance, in the absence of any noticeable interface beside the laptop, the performer's actions are somewhat mystifying to the audience.

For the above reasons we decided that the graphics tablet served as a potent tool for uniting the DJ (or electronic musician) and the VJ under a single interface. In addition by using the large surface of the tablet as an interaction device we created a dynamic performance instrument that the audience could relate to in a very physical manner.



Figure 3 - Video link: http://www.telebody.ws/TRACEY/EPI_Shanghai_02_edit.mov. *Exploding, Plastic and Inevitable Redux*. Digital Art Weeks, Shelter Club Shanghai, 2008. Steve Gibson - VJ. Stefan Müller Arisona - DJ. Video shot by Ika Arisona, edited by Steve Gibson.

Background: the graphics tablet as a performance instrument

As we began playing with the graphics tablet as a media control device it became quite clear to us that the tablet had a kind of idiomatic playing technique that worked very well in performance. The size of the tablet, combined with the pen as a fixed reference point, allowed us to explore it as a genuine media instrument. The audience was often transfixed by the user actions during live performance, confirming for us (at least anecdotally) the usefulness of the graphics tablet as a performance tool and electronic drawing as a performance medium.

Given that both of the authors are at best naïve drawers, we developed our own technique that is quite distinct from traditional or electronic drawing. At one point, we did consider having the drawing actions represented as a line in real-time, so that on one projection screen the live drawing would be projected and on a second screen the corresponding video results would be shown. This proved cumbersome to implement and ultimately we decided the aesthetic value of our drawings was insignificant compared to the video effects created by drawing. It is worth noting that we have shared our software with other artists who had a more developed background in drawing and they represented the live drawing aspect more thoroughly. In short they allowed the audience to draw using the tablet, and then by pressing a button on the tablet pen the user could switch to a mode in which they could apply effects to their drawing in real time. Simply put, the approach to drawing as a tool of media manipulation clearly has multiple and varied applications depending on the interests and abilities of the artists.

Our general approach to the tablet as a performance instrument has its roots in both our interest in alternative interfaces, and our lack of satisfaction with laptop performance. As described above, there is an on-going academic, theoretical and public debate about work consumed in a live situation in which the live element is impossible to perceive by the audience (i.e. laptop performance) or there is literally no live element (i.e. tape-based electro-acoustic music):

The use of computers in live performance has resulted in a situation in which cause-and-effect has effectively disappeared, for the first time since music began. Once we started to use computers in live performance – to interpret abstract gestures and generate sound as a result – the age-old relationship between gesture and result became so blurred as to be often imperceptible. (Schloss 2002)

While this may be acceptable in certain situations (e.g. DJing background music in a bar), for most live performance situations the audience responds most favourably to the correspondence between performer action and the result that they see or hear. The tablet provides a fixed point of reference for the performer and audience in the pen. The use of the drawing pen allows for both subtle and dramatic gesture. It also connects to the performer's hand, giving the audience a familiar referent that they will have most likely experienced in various types of live performance situations, whether it is the hands of the keyboardist playing the piano or the hand of the conductor waving a baton.

Initial research

Right at the outset we decided to use the graphics tablet as a MIDI device. In essence a MIDI device allows one to communicate data to audio and some types of video software as well as MIDI-equipped music instruments, and the data tells the receiver to play sounds or clips and to apply effects (for more information on the MIDI specification please see <http://www.midi.org/techspecs/index.php>). Our initial research into programming options for using MIDI with a Wacom tablet uncovered some pre-made applications, but in general we were unsatisfied with the both the usability and “look and feel” of these solutions. For example, one such application that we considered was the “Tablet 2 MIDI” (<http://www.livelab.dk/tablet2midi.php>) interface developed by Livelab in Denmark. This program allows complex mapping of MIDI data to multiple parts of the graphics tablet. The essential problem with this model is that it uses a complex menu-driven user-interface that is not intuitive. In addition the application is Windows-only, and given the fact that the authors (and much of the digital media community) are Mac users, we determined that this “off-the-

shelf” solution was not ultimately viable. If we wanted a solution that would meet our needs and the needs of a more general digital media community, it would be necessary to develop our own alternative application.

For this reason we decided to look at creating our own interface using Max from Cycling 74 (<http://cycling74.com/>). Max (in conjunction with MSP and Jitter) is a graphical programming environment for music, audio and media. Programs are created in Max by connecting modular graphical components (called external objects) into a network called a “patch.” In addition, Max has an application programming interface (API) that allows users to create their own external objects. The extensibility and modularity of Max has resulted in a large community of developers that create and share their custom Max external objects. To implement our interface we incorporated a Max external object designed by Olaf Matthes (<http://www.akustische-kunst.org/maxmsp/>) that outputs data produced by the Wacom Tablet. In the Max patch, the data from the Wacom tablet is routed and mapped to a series of user-definable MIDI messages that can then be used to produce audio and video manipulations and transformations.

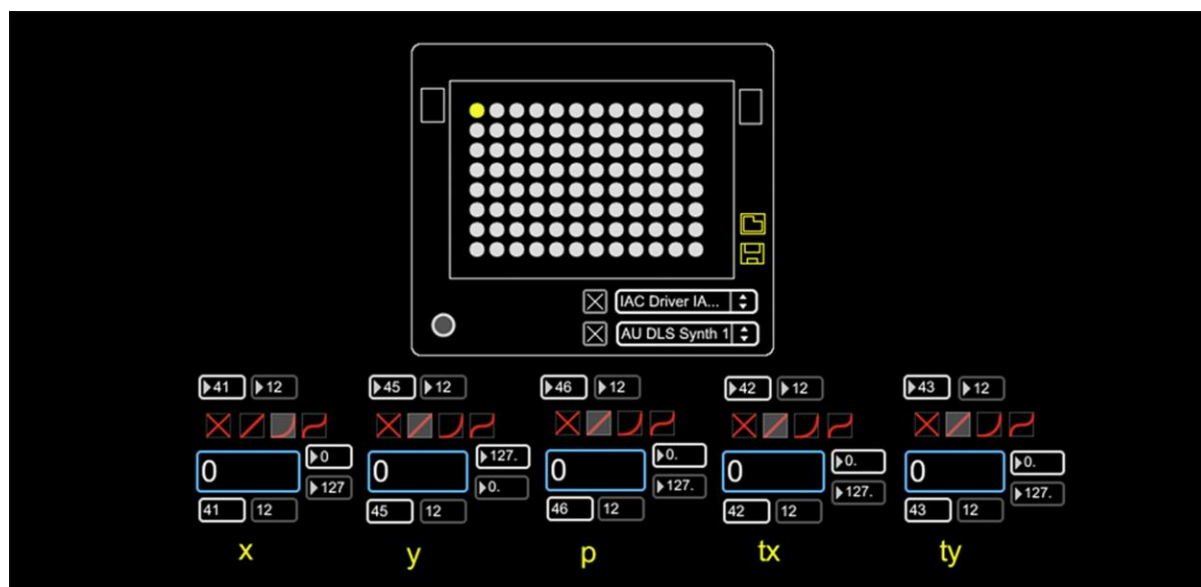


Figure 4 - Wacom MIDI interface, Justin Love and Steve Gibson, 2008-09.

Interface design

It was essential that the interface that we created be entirely contained in one window, with no need for submenus or even normal file menus. Figure 4 above illustrates our basic interface design. Side-to-side (x), up-and-down (y), pressure (p), tilt x (tx), and tilt y (ty) can each be mapped to any of 127 possible MIDI control change parameters on 16 different MIDI channels. In addition, control curves can be applied to each parameter. For example, a linear control curve produces a consistent rate of change for a given parameter, whereas an exponential control curve causes a parameter to change slowly at first and then increase rapidly towards the end. The MIDI output can be routed to two different MIDI ports simultaneously, thus allowing control of MIDI data via Interapplication MIDI (to another piece of MIDI software on the same machine) or out from the port of a MIDI interface (to another computer or to a MIDI device such as a synthesizer). The grid at the top allows the user to save up to 96 different MIDI control change setups in one file. Figure 5 below illustrates the function of each of the interface items.

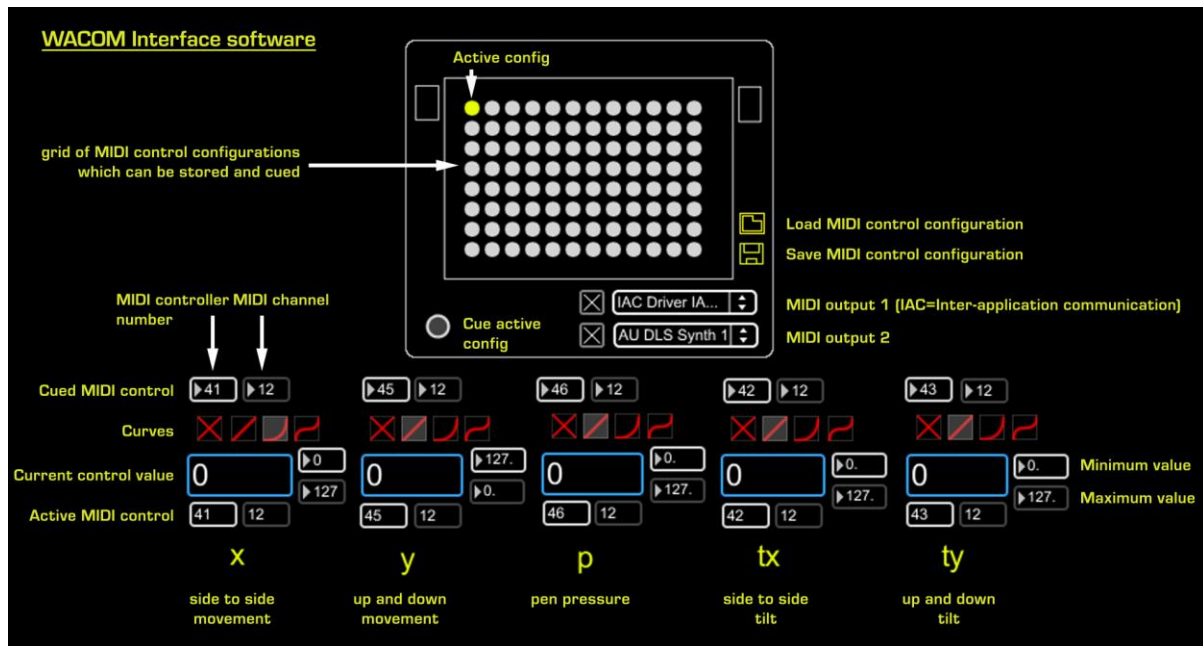


Figure 5 - Interface with explanation, Justin Love and Steve Gibson, 2008-09.

Connecting with audio and video

To connect our application with other MIDI software, we used the Interapplication MIDI driver which comes standard on the Mac OS. This allowed us to instantly map tablet actions to an effect or parameter in the audio or video software. Naturally only five tablet parameters can be used to control video or audio data at the same time, but it is possible to route the same MIDI control data to multiple functions in the video or audio applications. For example, simultaneous control of audio volume, audio pan, video opacity and video x position can be mapped with one tablet parameter (most logically x). With the grid of 96 storable configurations, once the user gets tired of the same configuration a new one can be loaded instantaneously. It is possible to cue a configuration (similar to how a DJ would cue a new track) and press one button to immediately activate the new setup.

The applications we use with our tablet audio-visual interaction are Ableton Live (for audio) and Modul8 (for video). Both of these programs are ideal for live audio-visual performance as they have extensive MIDI support and are built for non-linear performance situations in which the user may want to change, modify or apply effects to audio-visual materials instantaneously. Figure 6 shows how

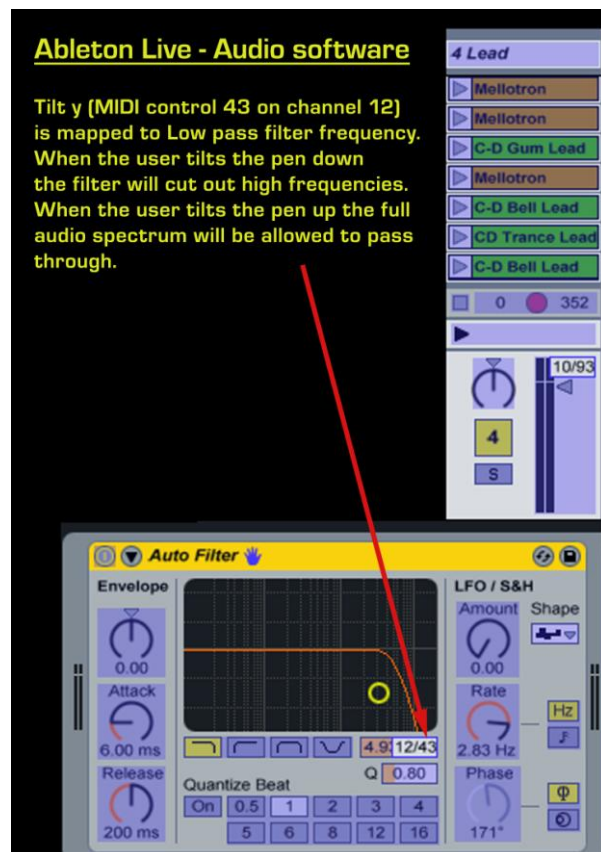


Figure 6 - Mapping tablet data to audio control in Ableton Live.

we mapped incoming MIDI data from the Wacom tablet to control an audio effect in Ableton Live. Figure 7 below illustrates how the same tablet parameter is mapped to multiple effects in Modul8.



Figure 7 - Mapping tablet data to video control in Modul8.

Using the tablet data via Interapplication MIDI allows for simultaneous control of multiple audio and video parameters, though in Figures 6 and 7 we control one audio parameter with one tablet parameter (tilt y) and three video parameters with the same data. Naturally controls from the remaining four tablet parameters can be assigned to Modul8 and Ableton Live parameters allowing the user to create a constant dance of tablet drawings to audio-visual effects.

The tablet as a live performance device

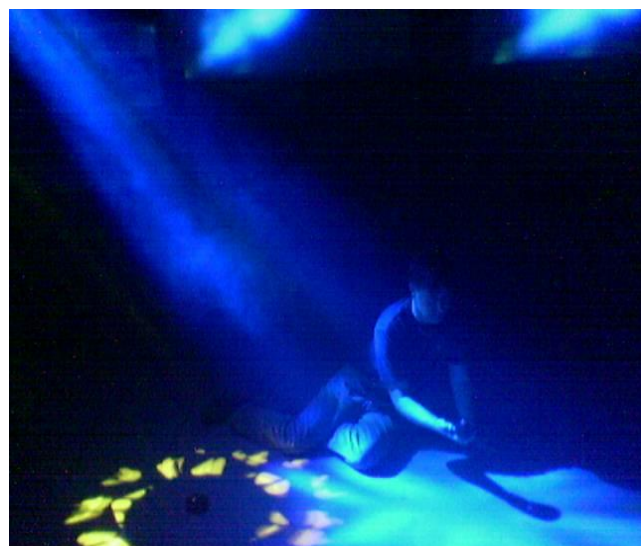


Figure 8 – Steve Gibson *Virtual DJ*. Live at Incubation Conference, July 2005, Stealth Attack, Nottingham. Photo by Jonathan Griffiths.

With the possibility of seemingly endless mappings of tablet data to corresponding audio and video effects we were acutely aware that some sort of logical mapping structure would have to be established in order to allow the interface to be used effectively in a performance situation. This harkens back to the concern that we had at the outset: we wanted to be sure that tablet actions had observable results so that audience members would be able to clearly identify the relationship between the live drawing and the performed audio-visual elements.

In the past Steve Gibson has worked on several projects which explore 3D interfaces and the connections between

audio and video mappings and 3D control. The most important of these projects was *Virtual DJ* (<http://www.telebody.ws/VirtualDJ/>), in which the user is given control over an audio environment and lighting effects by moving in 3D space. In short this project used standard control configurations between user actions and results in the audio-visual system. For example, raising the hands would generally play an upwards melody and with each new note a light would change colour. This allowed the user to identify that their motions were having observable and repeatable effects in both the audio and visual realms. In essence this simulated the effects of synaesthesia, a condition in which persons can often see colours in response to particular sounds, tones or musical notes: "Synesthesia is an involuntary joining in which the real information of one sense is accompanied by a perception in another sense." (Cytowic 1989, p.1)

In order to achieve the illusion of synaesthesia in *Virtual DJ* a series of relations was built up between user movements in 3D space and simultaneous light and sound changes. While these were not held to strictly, there was enough constancy in their application that users were able to navigate the audio-visual world with very little difficulty.

For our tablet interactions we thought of the tablet interface as a miniaturised version of the multi-dimensional spatial interface used in *Virtual DJ*. Thus logical interactions could be inferred by testing user actions with system results. For instance, drawing on the y-plane on the tablet (up-down) could logically map to audio volume or low-pass filter (which would have a similar effect to volume, without completely removing the sound at the bottom of the tablet) and image opacity. Therefore we built a limited series of controls to be employed by the user on the tablet and held to these controls throughout our performance. The videos in Figures 9 and 10 below show how three of the tablet parameters (x, y and p) were mapped to audio effects. In developing our tablet performance we proceeded in a rather intuitive manner when it came to mapping tablet data to audio and video effects. It soon became clear that certain effects worked more effectively than others. In addition it became clear that the needs of audio balance and visual clarity had to be considered in equal measure to the fluidity of the tablet interaction. Video compositing had to be carefully considered in order to achieve clarity in both the interaction and the video domain. Too many similar-looking video files would produce an unseemly mass of incongruous visual objects that the performer and viewers could not distinguish between. Therefore for the most part we used similar types of video and audio files mapped to the same tablet parameter. The x plane for example was linked to drum-based audio and text-based video almost exclusively for the final 45-minute performance. The y plane was linked to bass sounds and much more abstract video. This had the effect of making the interaction always logical, if not entirely predictable (given that both the drum and bass sounds, and the text-based and abstract videos changed throughout).

WACOM AUDIO DEMO 1

In the following example y movements (up-down) are used to control the filter of a bass sound and pressure is used to control bass resonance.

Figure 9 – Video link: http://www.telebody.ws/TRACEY/Tablet_demo1.mov. Video, Steve Gibson, 2010.

WACOM AUDIO DEMO 2

In this example drums are added to the bass from the previous example. X movements (side to side) are used to control the drum filter.

Figure 10 – Video link. http://www.telebody.ws/TRACEY/Tablet_demo2.mov. Video, Steve Gibson, 2010.

Conclusions

In summation we have found that the Wacom graphics tablet is a powerful device for controlling live audio and video in a performance situation. The act of live drawing, though here removed from its traditional reference to a produced “drawing” (either on-screen or in print), is one that allows for dramatic gesture in a way that pressing keys on a computer keyboard or moving a mouse could never hope to achieve. In addition the fact that the graphics tablet can unite five degrees of control over live audio and video makes it an ideal tool to consolidate the roles of the DJ and the VJ under one control interface. Finally we present a live example of the

tablet used in a performance situation with one of the authors controlling live audio and video with his drawing actions (Figure 11 below). Please see Appendix 1 below for information on how to download and use the Wacom MIDI software.

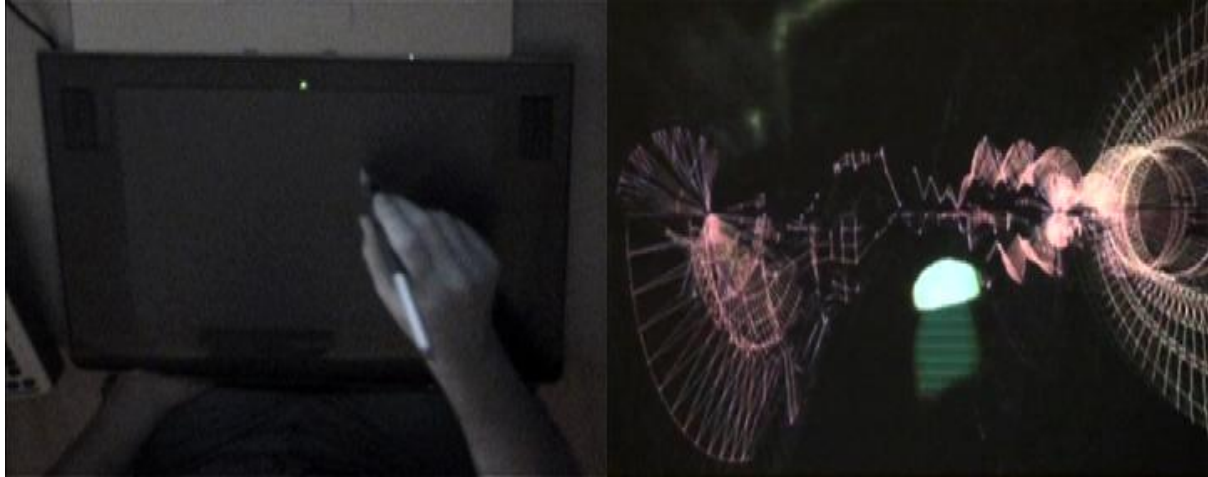


Figure 11 – Video Link: [http://www.telebody.ws/TRACEY/Tablet Demo Split.mov](http://www.telebody.ws/TRACEY/Tablet%20Demo%20Split.mov). *Wacom Tablet MIDI Demo*. Live performance by Steve Gibson, January 2010. Video by Steve Gibson, 2010.

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Graham, P., Russo, F.A. and Thompson, W.F., 2005. Seeing music performance: Visual influences on perception and experience. *Semiotica*, 156–1/4.

Schloss, W.A., 2002. Using Contemporary Technology in Live Performance: The Dilemma of the Performer. *Journal of New Music Research*, Vol. 31, No. 1.

Web Resources and Examples

Ableton Live website: <http://www.ableton.com/>

Adobe Reader website - <http://www.adobe.com/products/reader/>

Birmingham ElectroAcoustic Sound Theatre website: <http://www.beast.bham.ac.uk>

Cycling 74 Max MSP website: <http://cycling74.com/>

Garagecube Modul8 website: <http://www.garagecube.com/modul8/index.php>

Steve Gibson's Virtual DJ website: <http://www.telebody.ws/VirtualDJ/>

Korg Kaoss Pad website: <http://www.korg.com/product.aspx?pd=278>

Donna Leishman's 6amhoover website: <http://www.6amhoover.com/>

Live Lab Tablet 2 MIDI website: <http://www.livelab.dk/tablet2midi.php>

MIDI Manufacturers Association website - <http://www.midi.org/techspecs/index.php>

Noisefold website - <http://nfold.csf.edu/Pages/Noisefold.htm>

Olaf Matthes' external objects for Max/MSP - <http://www.akustische-kunst.org/maxmsp/>

Quicktime website - <http://www.apple.com/quicktime/download/>

Rogue Science Wacom MIDI software: <http://www.roguescience.org/wacom2MIDI.zip>

Wacom Intuos website: <http://www.wacom.com/intuos/>

Appendix 1: Downloading and using the Wacom MIDI software

The Wacom MIDI software can be downloaded at:

<http://www.roguescience.org/wacom2MIDI.zip>.

At present the software is Macintosh native and works only with Wacom tablets. It will function with many different models of the Wacom tablet. To use the Wacom MIDI software you will need a basic knowledge of MIDI and access to MIDI software. Trial versions of both Ableton Live (<http://www.ableton.com/downloads>) and Modul8 (<http://www.garagecube.com/modul8>) can be downloaded free of charge. You will also need to make sure the IAC driver is activated in Applications/Utilities/Audio MIDI Setup as follows.



Figure 12 - Using the IAC MIDI driver in Audio MIDI Setup

If you are using Ableton Live you will also need to ensure that Live is receiving MIDI data from the IAC driver. Under the Live menu/Preferences please set your MIDI to the following:



Figure 13 - Activating the IAC MIDI driver in Ableton Live

The first video (Figure 14) below demonstrates how to create a setup for controlling MIDI software with the tablet. The second video (Figure 15) shows how to load your saved setup and apply curves to the different tablet parameters.

If you use the software in a project please credit the authors, Steve Gibson and Justin Love.

WACOM MIDI SETUP

In this example we assign
MIDI controls to each tablet
parameter and save the setup.

Figure 14 – Video link: http://www.telebody.ws/TRACEY/Wacom_MIDI_Setup_Demo.mov. How to setup the Wacom MIDI software to use with your Wacom tablet. Video by Steve Gibson, 2010.

LOAD MIDI SETUP

In this example we load
the Wacom MIDI setup
that we saved earlier.

Figure 15 – Video link: http://www.telebody.ws/TRACEY/Wacom_MIDI_Load_Demo.mov. How to load your saved setup. Video by Steve Gibson, 2010.